

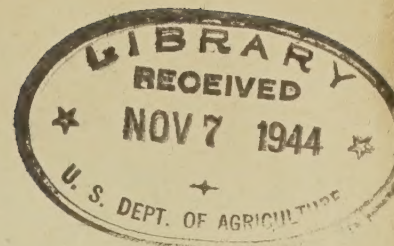
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2 AGRICULTURAL NOTES

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8  
THE INTRODUCTION INTO PUERTO RICO OF BENEFICIAL INSECTS  
TO AID IN THE CONTROL OF THE HORN FLY OF CATTLE

BY

KENNETH A. BARTLETT, ASSISTANT ENTOMOLOGIST,  
DIVISION OF FOREIGN PARASITE INTRODUCTION,  
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE,  
UNITED STATES DEPARTMENT OF AGRICULTURE /1

THE HORN FLY OF CATTLE IS A SERIOUS PEST IN PUERTO RICO.

THE HORN FLY OF CATTLE, HAEMATOBIA IRRITANS (L.) IS A COMMON SPECIES OF  
BLOODSUCKING FLY THAT ATTACKS CATTLE AND HORSES. THE FLY MAY BE READILY OBSERVED  
FEEDING IN LARGE NUMBERS ON THE FLANKS OF CATTLE AND IS ABOUT HALF THE SIZE OF AN  
ORDINARY HOUSE FLY.

THE SPECIES IS ABUNDANT ON THE SOUTH COAST OF PUERTO RICO, WHERE IT IS  
KNOWN AS A SERIOUS PEST. WHILE LESS COMMON IN OTHER AREAS OF THE ISLAND IT MAY  
BECOME A PEST THERE DURING CERTAIN SEASONS OF THE YEAR.

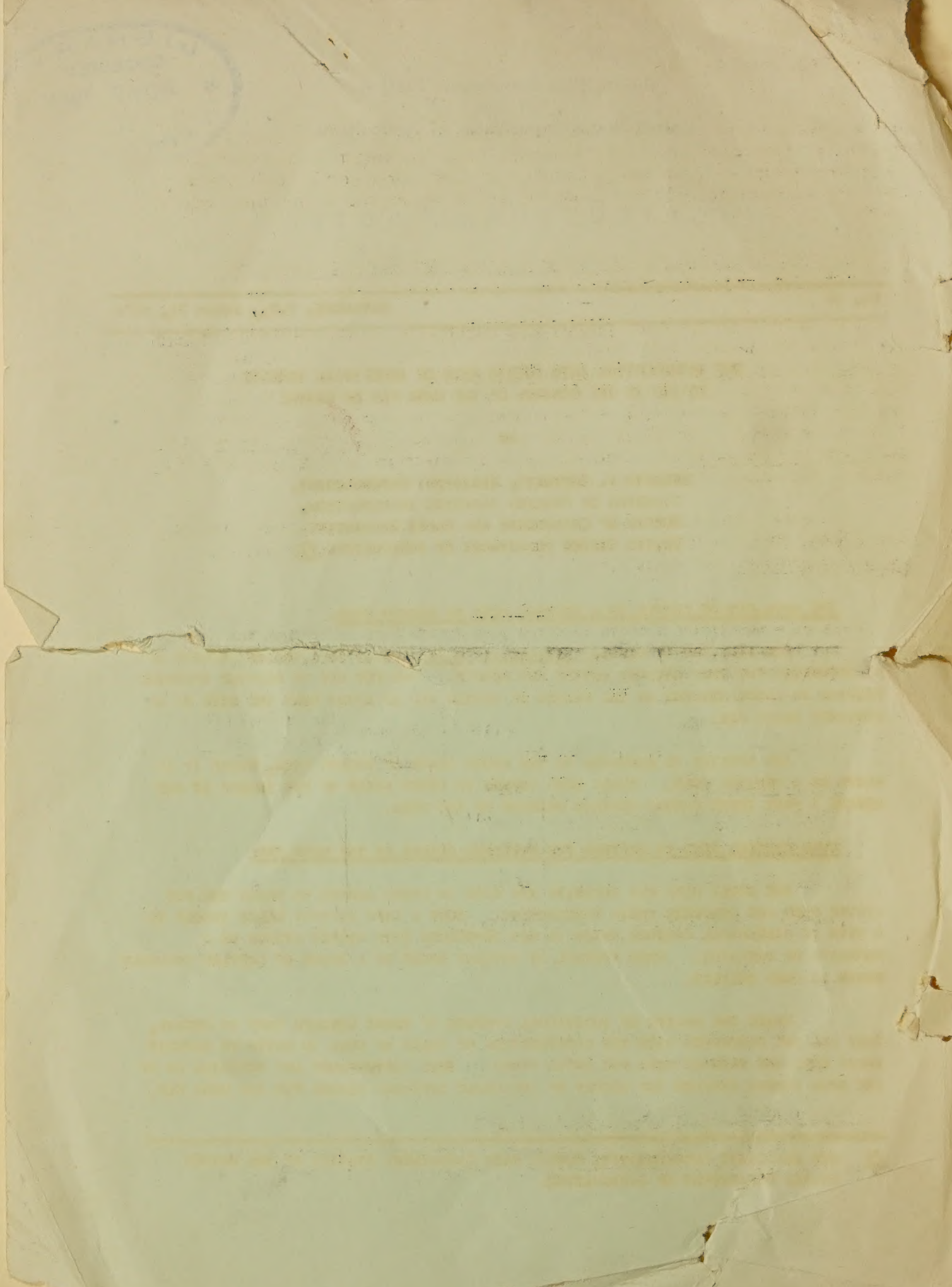
DUNG BEETLES TEND TO DESTROY THE BREEDING PLACES OF THE HORN FLY.

THE ADULT HORN FLY DEPOSITS ITS EGGS IN FRESH MANURE ON WHICH THE FLY  
LARVAE FEED AND COMPLETE THEIR DEVELOPMENT. SUCH A LIFE HISTORY LENDS ITSELF TO  
A TYPE OF BIOLOGICAL CONTROL WHICH IS NOT CONCERNED WITH DIRECT ATTACK BY A  
PARASITE OR PREDATOR. SUCH CONTROL IS BROUGHT ABOUT BY A GROUP OF BEETLES COMMONLY  
KNOWN AS DUNG BEETLES.

WHILE THE HABITS OF INDIVIDUAL SPECIES OF THESE BEETLES VARY IN DETAIL,  
THEY ALL ARE CONCERNED WITH THE CONSTRUCTION OF BALLS OF DUNG IN WHICH TO DEPOSIT  
THEIR EGGS AND PROVIDE FOOD FOR THEIR YOUNG. THIS DISTURBANCE AND BREAKING UP OF  
THE DUNG CLUMPS REDUCES THE AMOUNT OF AVAILABLE BREEDING PLACES FOR THE HORN FLY.

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/1 NOW ASSOCIATE ENTOMOLOGIST, PUERTO RICO EXPERIMENT STATION OF THE UNITED  
STATES DEPARTMENT OF AGRICULTURE.



THROUGH THE COOPERATION OF THE BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE AND THE PUERTO RICO EXPERIMENT STATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE, A NUMBER OF SPECIES OF THESE DUNG BEETLES AND ALSO ONE SPECIES OF A TRUE INTERNAL PARASITE WERE IMPORTED INTO PUERTO RICO TO AID IN THE CONTROL OF THIS LIVESTOCK PEST.

BENEFICIAL INSECTS WERE IMPORTED INTO PUERTO RICO FROM THE CONTINENTAL UNITED STATES AND HAWAII.

AN INTERNAL PARASITE, SPALANGIA PHILIPPINENSIS FULL., WHICH ATTACKS HORN FLY PUPARIA WAS IMPORTED FROM HAWAII ALONG WITH TWO SPECIES OF DUNG BEETLES, COPRIS INCERTUS VAR. PROCIDUUS (SAY) AND ONTHOPHAGUS INCENSUS. THIS MATERIAL FROM HAWAII WAS ASSEMBLED BY O. C. MCBRIDE OF THE BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE AND D. T. FULLAWAY OF THE BOARD OF COMMISSIONERS OF AGRICULTURE AND FORESTRY, TERRITORY OF HAWAII. TWO OTHER SPECIES OF DUNG BEETLES, CANTHON PILULARIUS (L.) AND PHAENUS TRIANGULARIS SAY, ASSEMBLED UNDER THE DIRECTION OF D. C. PARMAN OF THE BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE, WERE IMPORTED FROM TEXAS.

TABLE I IS A SUMMARY OF THE SPECIES OF BENEFICIAL INSECTS THUS IMPORTED DURING 1936, 1937, AND 1938, TO AID IN THE CONTROL OF THE HORN FLY OF CATTLE, HAEMATOBIA IRRITANS, IN PUERTO RICO.

TABLE I. - BENEFICIAL INSECTS IMPORTED INTO PUERTO RICO TO CONTROL THE HORN FLY OF CATTLE, DURING 1936, 1937, AND 1938, GIVING SPECIES, ORIGIN, NUMBER OF SHIPMENTS, AND NUMBER RECEIVED ALIVE

SPECIES	ORIGIN	SHIPMENTS	INDIVIDUALS RECEIVED ALIVE
		NUMBER	NUMBER
<u>CANTHON PILULARIUS</u> .....	TEXAS	4	17,216
<u>COPRIS INCERTUS</u> VAR. <u>PROCIDUUS</u> ...	HAWAII /1	3	93
<u>ONTHOPHAGUS INCENSUS</u> .....	HAWAII	2	341
<u>PHAENUS TRIANGULARIS</u> .....	TEXAS	1	8
<u>SPALANGIA PHILIPPINENSIS</u> .....	HAWAII /2	3	80
TOTAL .....		13	17,738

/1 INTRODUCED INTO HAWAII FROM MEXICO.

/2 INTRODUCED INTO HAWAII FROM THE PHILIPPINE ISLANDS.

COPRIS INCERTUS WAS REARED IN THE LABORATORY.

THE REARING OF COPRIS INCERTUS IN THE LABORATORY WAS UNDERTAKEN IN ORDER TO SUPPLEMENT THE NUMBERS AVAILABLE FOR LIBERATION. THE METHODS FOLLOWED



WERE SIMILAR TO THOSE USED BY LINDQUIST <sup>1</sup>. WOODEN BOXES APPROXIMATELY 20 X 12 X 12 INCHES WITH THE TOPS AND BOTTOMS REMOVED WERE PLACED ON SOLID FLOOR BOARDS. EIGHT INCHES OF SANDY LOAM SOIL WAS PLACED IN EACH BOX, WHICH WAS PROVIDED WITH A SCREEN WIRE COVER TO PREVENT THE ESCAPE OF THE INTRODUCED BEETLES. SMALL PILES OF FRESH CATTLE DUNG WERE PLACED ON TOP OF THE SOIL EVERY THIRD DAY AND THE SOIL MOISTENED SLIGHTLY. EVERY 14 DAYS THE WOODEN SHELL OF THE BOX WAS LIFTED AND THE EGG BALLS REMOVED.

IN THIS REARING WORK, EACH FEMALE BEETLE WAS OBSERVED TO BURROW TO A DEPTH OF ABOUT 6 INCHES IN CONSTRUCTING AN EARTHEN CHAMBER OR NEST TO HOLD THE OVOID TO SPHERICAL AND WELL-POLISHED EGG BALLS, WHICH SHE CONSTRUCTED OF DUNG. THE FEMALE BEETLE SPENT CONSIDERABLE TIME WITHIN THE NEST IN SHAPING AND POLISHING THESE BALLS, EACH OF WHICH CONTAINED AN EGG. ON HATCHING, THE BEETLE LARVA FED WITHIN THE BALL UNTIL ITS DEVELOPMENT WAS COMPLETE. WHILE NO DETAILED STUDY WAS MADE CONCERNING OTHER PHASES OF THE LIFE HISTORY, OBSERVATIONS SHOWED THAT THE PERIOD OF DEVELOPMENT FROM EGG TO ADULT WAS APPROXIMATELY 2 MONTHS.

THE BREEDING WORK WITH C. INCERTUS WAS STARTED IN JULY AND TERMINATED IN OCTOBER, 1936. DURING THAT PERIOD A TOTAL OF 370 BALLS WAS RECOVERED FROM THE REARING BOXES. THE BREEDING WORK WAS TERMINATED DUE TO A SEVERE INFESTATION OF MITES WHICH DEVELOPED UNDER LABORATORY CONDITIONS. A TOTAL OF 67 ADULTS WAS USED FOR THIS REARING AND 38 OF THESE WERE ALIVE AT THE TERMINATION OF THE WORK.

SPALANGIA PHILIPPINENSIS WAS ALSO REARED IN THE LABORATORY.

THE PUPAL PARASITE OF THE HORN FLY, SPALANGIA PHILIPPINENSIS, INTRODUCED FROM HAWAII, WAS ALSO REARED IN THE LABORATORY. THIS PARASITE IS NOT SPECIFIC IN HABITS AND IS KNOWN TO ATTACK DIPTEROUS PUPARIA IN GENERAL. IN THE LABORATORY IT WAS SUCCESSFULLY REARED ON SIX SPECIES OF DIPTERA, HAEMATOBIA IRRITANS, MUSCA DOMESTICA L., STOMOXYS CALCITRANS (L.), ANASTREPHA SUSPENSUS LOEW., ANASTREPHA MOMBINPRAEOPTANS SEIN, AND SARCOPHAGULA SP. BY FAR THE BEST RESULTS IN THE LABORATORY WERE OBTAINED WHEN PUPARIA OF THE HOUSEFLY AND STABLEFLY, M. DOMESTICA AND S. CALCITRANS, WERE USED. FRESHLY FORMED PUPARIA YIELDED A HIGHER PERCENTAGE OF PARASITES THAN DID OLDER PUPARIA.

PUPARIA OF THE HOUSEFLY AND STABLEFLY WERE OBTAINED IN LARGE NUMBERS FROM MANURE PILES AT THE STABLES OF RUSSELL & CO., HORMIGUEROS. THE INFESTED MANURE WAS PLACED ON A  $\frac{1}{4}$ -INCH MESH WIRE SCREEN BENEATH WHICH WAS CONSTRUCTED AN INCLINED PLANE OF CELLULOID. THE FLY LARVAE ON COMPLETING DEVELOPMENT LEFT THE DUNG AND FELL TO THE CELLULOID SURFACE WHERE THEY ROLLED INTO SLOPING GUTTERS LEADING TO A CENTRAL COLLECTION PAN.

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<sup>1</sup> LINDQUIST, A. W. NOTES ON THE HABITS OF CERTAIN COPROPHAGOUS BEETLES AND METHODS OF REARING THEM. U.S.D.A. CIRCULAR NO. 351, MAY 1935.



THOUSANDS OF DIPTEROUS PUPARIA WERE EXPOSED TO REAR SPALANGIA.

SINCE THE START OF THE REARING WORK WITH S. PHILIPPINENSIS IN SEPTEMBER 1936, A TOTAL OF 37,828 PUPARIA WERE EXPOSED TO ADULT PARASITES IN CAGES UP TO THE TERMINATION OF THE BREEDING WORK IN JANUARY 1938. THESE PUPARIA CONSISTED OF THE FOLLOWING: 31,293 M. DOMESTICA AND S. CALCITRANS, 3,884 ANASTREPHA SPP., 1,500 H. IRRITANS, 1,151 SARCOPHAGULA SP. THERE EMERGED FROM THESE PUPARIA 12,665 ADULTS OF S. PHILIPPINENSIS.

THE PERIOD OF DEVELOPMENT FOR THIS SPECIES, FROM EXPOSURE OF THE PUPARIA TO EMERGENCE OF THE ADULT PARASITE, VARIED FROM 22 TO 41 DAYS. WEIGHTED AVERAGES COMPUTED FOR THE MONTHS OF NOVEMBER TO MARCH, INCLUSIVE, VARIED FROM 30.4 TO 31.6 DAYS, WHEREAS DURING THE OTHER MONTHS OF THE YEAR, WHICH ARE WARMER, THE AVERAGE DEVELOPMENTAL PERIOD WAS BETWEEN 28.1 AND 29.0 DAYS. THE ABOVE RECORDS ARE BASED ON REARINGS MADE FROM PUPARIA OF THE HOUSEFLY AND STABLEFLY. THE PERIOD OF DEVELOPMENT IN FRUITFLY PUPARIA WAS 2 TO 3 DAYS LONGER IN THE CASES RECORDED.

DUNG BEETLES AND SPALANGIA WERE LIBERATED THROUGHOUT THE ISLAND.

TABLE 2, WHICH FOLLOWS, IS A SUMMARY OF THE LIBERATIONS OF THE VARIOUS SPECIES OF DUNG BEETLES AND THE PARASITE SPALANGIA PHILIPPINENSIS IN PUERTO RICO DURING 1936, 1937, AND 1938. THE SHIPMENTS OF CANTHON PILULARIUS ARRIVING DURING JUNE AND JULY, 1938, WERE RECEIVED AND LIBERATED BY H. K. PLANK, ASSOCIATE ENTOMOLOGIST, WHO WAS ACTING FOR THE AUTHOR WHILE ON LEAVE.

TABLE 2. - THE LIBERATIONS OF DUNG BEETLES AND SPALANGIA PHILIPPINENSIS TO AID IN THE CONTROL OF THE HORN FLY, H. IRRITANS, DURING 1936, 1937, AND 1938, GIVING LOCALITIES, DATES, SPECIES, AND NUMBERS LIBERATED

LOCALITIES AND DATES	<u>CANTHON PILULARIUS</u>	<u>COPRIS INCERTUS</u>	<u>ONTHOPHAGUS INCERTUS</u>	<u>PHAENUS TRIANGULARIS</u>	<u>SPALANGIA PHILIPPINENSIS</u>
	<u>NUMBER</u>	<u>NUMBER</u>	<u>NUMBER</u>	<u>NUMBER</u>	<u>NUMBER</u>
GUÁNICA,					
JULY 17, 1936.....	1,528	.....	.....	.....	.....
JUNE 24, 1937.....	.....	.....	.....	.....	1,139
LAJAS,					
JULY 17, 1936.....	2,763	.....	.....	.....	.....
AUG. 4, 1936 .....	.....	.....	184	.....	.....
AUG. 18? 1936.....	.....	.....	157	.....	.....
JAN. AND FEB. 1937.	.....	.....	.....	.....	671
MAY 1937 .....	.....	.....	.....	.....	512
MAYAGÜEZ,					
JULY 17, 1936.....	582	.....	.....	.....	.....
AUG. 27, 1936.....	1,262	.....	.....	.....	.....
AUG.-NOV. 1937.....	.....	.....	.....	.....	2,408



TABLE 2, CONTINUED. - THE LIBERATIONS OF DUNG BEETLES AND SPALANGIA PHILIPPINENSIS TO AID IN THE CONTROL OF THE HORN FLY, H. IRRITANS, DURING 1936, 1937, AND 1938, GIVING LOCALITIES, DATES, SPECIES, AND NUMBERS LIBERATED

LOCALITIES AND DATES	<u>CANTHON</u> <u>PILULARIUS</u>	<u>COPRIS</u> <u>INCERTUS</u>	<u>ONTHOPHAGUS</u> <u>INCERTUS</u>	<u>PHAENUS</u> <u>TRIANGULARIS</u>	<u>SPALANGIA</u> <u>PHILIPPINENSIS</u>
	<u>NUMBER</u>	<u>NUMBER</u>	<u>NUMBER</u>	<u>NUMBER</u>	<u>NUMBER</u>
HORMIGUEROS, JULY 22, 1936.....	.....	.....	.....	8	.....
OCT. 1936 .....	.....	330/1	.....	.....	.....
OCT. 1936-JAN. 1937.....	.....	.....	.....	.....	1,138
SANTA ISABEL, MAR. 10, 1937.....	.....	.....	.....	.....	714
JUANA DIAS, MAR. 30, 1937.....	.....	.....	.....	.....	314
BOQUERÓN, APR. 16, 1937.....	.....	.....	.....	.....	643
MAY 27, 1937 .....	.....	.....	.....	.....	780
LAS MARÍAS, APR. 22, 1937.....	.....	.....	.....	.....	465
MARICAO, MAY 21, 1937 .....	.....	.....	.....	.....	461
VEGA ALTA, MAY 10, 1937 .....	.....	.....	.....	.....	515
PONCE, JUNE 4, 1937 .....	.....	.....	.....	.....	317
JULY 5, 1938 .....	712	.....	.....	.....	.....
ARROYO, JUNE 17, 1938.....	925	.....	.....	.....	.....
SALINAS, JUNE 17, 1938.....	1,851	.....	.....	.....	.....
FARJARDÓ, JUNE 25, 1938.....	553	.....	.....	.....	.....
PEÑUELAS, JULY 5, 1938 .....	588	.....	.....	.....	.....
TOTAL.....	11,064	330	341	8	10,077

1 FIFTY-FOUR ADULTS AND 276 BALLS CONTAINING LARVAE REARED IN THE LABORATORY.



SPALANGIA PHILIPPINENSIS WAS RECOVERED AT JUANA DÍAS.

TWO SPECIMENS OF SPALANGIA, PROBABLY PHILIPPINENSIS, WERE RECOVERED AT JUANA DÍAS ON JULY 7, 1937, SOME 4 MONTHS AFTER LIBERATIONS HAD BEEN MADE IN THIS AREA. A. B. GAHAN OF THE BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE, WHO IDENTIFIED THE MATERIAL, REPORTS AS FOLLOWS: "THESE SPALANGIA SEEM TO BE THE SPECIES RECENTLY IMPORTED FROM HAWAII WHICH I HAVE PREVIOUSLY IDENTIFIED AS S. PHILIPPINENSIS. I CANNOT BE CERTAIN OF THE IDENTIFICATION AS I HAVE NOT THE TYPE OF PHILIPPINENSIS AND IT IS IMPOSSIBLE TO BE SURE OF ANY SPALANGIA ON THE BASIS OF THE DESCRIPTION." THESE TWO SPECIMENS WERE REARED FROM PUPARIA OF ANASTREPHA ACIDUSA.

H. L. DOZIER, FORMERLY OF THE BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE, WHILE WORKING ON THE HORN FLY IN PUERTO RICO DURING 1935-36, RECORDED ONE NATIVE SPECIES OF HORN FLY PARASITE, SPALANGIA HACNATOBIÆ ASHM. THIS SPECIES, LIKE PHILIPPINENSIS, IS A PUPAL PARASITE. IN ADDITION TO THE ABOVE SPECIES, THE WRITER ALSO REARED A SINGLE SPECIMEN OF SPALANGIA DROSOPHILÆ ASHM. <sup>1</sup> FROM A COLLECTION OF HORN FLY PUPARIA MADE AT LAKE GUÁNICA ON SEPTEMBER 22, 1936.

NATIVE PARASITES WERE REARED FROM FIELD-COLLECTED PUPARIA.

IN THE COURSE OF THE FOREGOING REARING WORK WITH SPALANGIA, A NUMBER OF NATIVE PARASITES OF THE HOUSEFLY AND STABLEFLY WERE REARED FROM FIELD-COLLECTED MATERIAL. THE MOST COMMON PARASITE FOUND WAS SPALANGIA MUSCICARUM RICH. <sup>1</sup> WHICH PARASITIZED AS HIGH AS 30 PERCENT OF SOME OF THE PUPARIA IN SOME COLLECTIONS. IN ONE COLLECTION A PARASITISM OF 10 PERCENT WAS RECORDED BY A SPECIES OF ASHMEADOPRIA, APPARENTLY NEW AND UNDESCRIBED. <sup>2</sup> TWO OTHER NATIVE PARASITES WERE ALSO REARED IN SMALL NUMBERS, PACHYCREPOIDEUS DUBIUS ASHM. <sup>2</sup> AND MUSCIDIFURAX RAPTOR GIR. AND SAND. <sup>4</sup>

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<sup>1</sup> DETERMINED BY A. B. GAHAN, BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE.

<sup>2</sup> DETERMINED BY C. F. W. MUESEBECK, BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE.

